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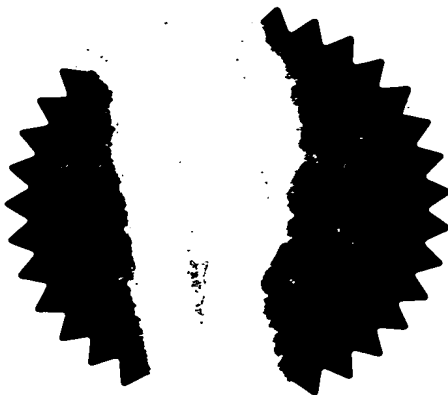
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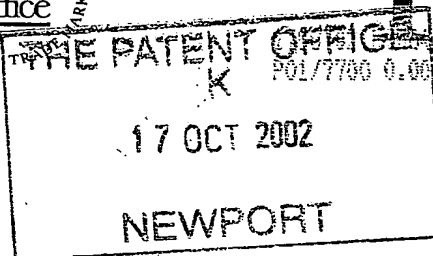
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1. Your reference	P30242-/NGR/NHE/GMU		
2. Patent application number (The Patent Office will fill in this part)	0224130.5		17 OCT 2002
3. Full name, address and postcode of the or of each applicant (underline all surnames)	Perkins Engines Company Eastfield Peterborough PE1 5NA 8486110001		
Patents ADP number (if you know it)			
If the applicant is a corporate body, give the country/state of its incorporation	United Kingdom		
4. Title of the invention	"Engine Air Charge System with Branch Conduits"		
5. Name of your agent (if you have one)	Murgitroyd & Company		
"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)	Scotland House 165-169 Scotland Street Glasgow G5 8PL		
Patents ADP number (if you know it)	1198015 ✓		
6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number	Country	Priority application number (if you know it)	Date of filing (day / month / year)
7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application	Number of earlier application		Date of filing (day / month / year)
8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if: a) any applicant named in part 3 is not an inventor, or b) there is an inventor who is not named as an applicant, or c) any named applicant is a corporate body. See note (d))	Yes		

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Description	8 ✓
Claim(s)	5 ✓
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Priority documents	-
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Statement of inventorship and right to grant of a patent (<i>Patents Form 7/77</i>)	-
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11. I/We request the grant of a patent on the basis of this application.

Signature

Murgitroyd & Co

Murgitroyd & Company

Date

16 October 2002

12. Name and daytime telephone number of person to contact in the United Kingdom

Graham Murnane

0141 307 8400

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1 "Engine Air Charge System with Branch Conduits"

2
3 TECHNICAL FIELD

4
5 This invention relates to a air charge system for a
6 'V' configuration internal combustion engine in which
7 two banks of cylinders are arranged to be inclined to
8 each other, and is particularly but not exclusively
9 applicable to an air charge system in which the boost
10 air from the compressor of a turbocharger is cooled
11 by an intercooler before being directed to the air
12 inlet ports of the internal combustion engine.

13
14 BACKGROUND

15
16 It is known to use turbochargers and other air charge
17 means to increase the performance of internal
18 combustion engines by delivering air at a higher
19 pressure to the cylinders of the engine. It is also
20 known to use an air-to-air aftercooler (also known as

1 an intercooler) in combination with a turbocharger.
2 When the turbocharger compresses air, the air
3 naturally heats up, and this reduces its density.
4 The aftercooler cools the air to increase the density
5 and thereby increase the mass of air delivered to the
6 cylinders. However when a turbocharger and
7 intercooler are used in a 'V' configuration engine,
8 it is necessary to provide two turbochargers and two
9 intercoolers, one for each bank of cylinders.
10 Moreover the air ducts which deliver the charged air
11 to the inlet manifolds can be relatively long and
12 complex in shape.

13
14 The present invention provides a charge air system
15 for a 'V' configuration internal combustion engine
16 which overcomes one or more of these problems.

17
18 SUMMARY OF THE INVENTION

19
20 The present invention provides a charge air system
21 for delivering charged air from a compressor to a 'V'
22 configuration internal combustion engine having first
23 and second spaced banks of cylinders each defining a
24 plurality of combustion chambers. The charge air
25 system comprises a compressor outlet and a charge air
26 cooler having an inlet and an outlet, the inlet being
27 in communication with the compressor outlet. The
28 system also comprises a first branch conduit adapted
29 for communication with the first bank of cylinders, a
30 second branch conduit adapted for communication with
31 the second bank of cylinders, and a flow control

1 valve in communication with the outlet of the charge
2 air cooler and with the first and second branch
3 conduits.

4
5 The present invention also provides a method of
6 delivering charged air from a compressor to a 'V'
7 configuration internal combustion engine having first
8 and second spaced banks of cylinders each defining a
9 plurality of combustion chambers, comprising:

10 causing charge air to flow from a compressor
11 outlet along a conduit disposed in the 'V' between
12 the first and second spaced banks of cylinders to a
13 charge air cooler;
14 cooling the charge air at the charge air cooler;
15 causing cooled charge air to flow from the
16 charge air cooler to a flow control valve; and
17 controlling the flow of cooled charge air to a
18 first branch conduit connected to the first bank of
19 cylinders and a second branch conduit connected to
20 the second bank of cylinders by adjusting the flow
21 control valve.

22

23 BRIEF DESCRIPTION OF THE DRAWINGS

24

25 Figure 1 is a side elevation of a charge air system
26 according to a first embodiment of the present
27 invention mounted on a 'V' configuration internal
28 combustion engine;

29

30 Figure 2 is a perspective view of the charge air
31 system of Figure 1;

1 Figure 3 is an end elevation of the charge air system
2 and 'V' configuration internal combustion engine of
3 Figure 1.

4

5 DETAILED DESCRIPTION

6

7 Referring to the drawings, one embodiment of the
8 present invention is now described, by way of example
9 only.

10

11 Figure 1 shows a 'V' configuration sixteen cylinder
12 internal combustion engine 10. The cylinders are
13 arranged in the cylinder block 15 of the engine in
14 two spaced banks 16 of eight cylinders, of which one
15 bank 16 is visible in Figure 1. The two banks 16 of
16 cylinders are inclined and define a 'V' space between
17 the banks. The 'V' space is seen most clearly in
18 Figure 3 and is bounded by planes 18 in which lie the
19 centre lines of the cylinders in each bank 16.

20 Although the illustrated embodiment shows an engine
21 having sixteen cylinders, it will be understood that
22 other cylinder configurations are possible, for
23 example eight or twelve cylinders. Although the
24 illustrated embodiment shows a compression ignition
25 engine, it will be understood that the invention
26 could also be applied to a spark ignition engine.

27

28 Each bank of cylinders has an associated engine
29 ignition wiring rail 60, while each cylinder has an
30 associated engine ignition transformer 62. Each bank
31 16 of cylinders also has an associated branch conduit

54, 56. Each branch conduit 54, 56 has a straight portion 58 delivering cooled charge air to the cylinders of the associated bank 16.

Referring to Figures 1 and 2 the components of the charge air system 12 are described. Figure 2 shows the charge air system 12 of Figure 1 with the engine removed for clarity. The engine 10 has a single conventional turbocharger 20 located at a first end 13 of the engine 10. The turbocharger 20 has a compressor 21 with a gas/air inlet 22 and exhaust gas inlets 24. The exhaust gas outlet 26 is connected to the engine exhaust system, while the compressor outlet 28 delivers compressed charge air to a compressor outlet duct 30. The invention is not limited to compressors driven by a turbocharger, and other means may be used to drive the compressor 21, such as a supercharger.

Charge air flows from the duct 30 to a substantially straight charge air conduit 32 disposed in the 'V' between the two banks of cylinders. The 'V' is considered to extend above the tops of the cylinders in the two banks, and it is understood that the charge air conduit 32 may be higher or lower with respect to the cylinders than the position shown in Figure 1. The 'V' typically has an internal angle of 60° , but the angle can be greater or smaller than 60° . In a particular embodiment of the invention the 'V' may have an internal angle of 180° so that the

1 banks of cylinders lie flat in an opposed
2 configuration.

3
4 Charge air flows along the charge air conduit 32 in
5 the direction of the arrow 80 shown in Fig. 2 to a
6 charge air cooler 40 having an inlet 34 and an outlet
7 36. The charge air cooler 40 is conventional and has
8 a jacket water inlet 42, a raw water inlet 44, a
9 jacket water outlet 46 and a secondary water outlet
10 48. In the illustrated embodiment the charge air
11 cooler 40 is disposed at a second end 14 of the
12 engine in the 'V' between the two banks of cylinders,
13 although it may be positioned lower at the end of the
14 cylinder block 15 in a similar position to that
15 occupied by the turbocharger compressor 20, to fit
16 with other engine components or other apparatus with
17 which the engine 10 is to be used. Similarly, the
18 position of the turbocharger compressor 20 may be
19 varied to suit circumstances.

20
21 Cooled charge air flows from the outlet 36 of the
22 charge air cooler 40 in the direction of the arrow 84
23 shown in Fig. 2 to a flow control valve 50. The flow
24 control valve 50 may be a throttle valve 50
25 controlled electrically or mechanically by a control
26 system (not shown) to control by restriction the flow
27 of cooled charge air to the cylinders. In the
28 preferred embodiment the valve 50 is a butterfly
29 valve. Beneath the valve 50 is a 'Y' branch
30 connector 52 having one inlet 70 and two outlets 72,
31 74. Connected to each outlet 72, 74 is a branch

1 conduit 54, 56. The first branch conduit 54 takes
2 cooled charge air to the first bank of cylinders,
3 while the second branch conduit 56 takes cooled
4 charge air to the second bank of cylinders. Each
5 branch conduit 54, 56 includes a substantially
6 straight portion 58 disposed on the opposite side of
7 the respective bank of cylinders 16 to the central
8 charge air conduit 32.

9
10 INDUSTRIAL APPLICABILITY

11
12 The charge air system 12 of the present invention
13 provides cooled charge air to a 'V' configuration
14 engine 10 while requiring only one compressor 21 and
15 one charge air cooler 40. Air is compressed and
16 heated by the compressor 21 and then is driven along
17 a single charge air conduit 32 disposed in the 'V'
18 between the spaced banks of cylinders, in the
19 direction of the arrow 82 shown in Fig. 2. The
20 charge air cooler 40 cools the charge air for both
21 banks of cylinders before the flow of charge air is
22 split into two by the 'Y' branch connector 52. A
23 single flow control valve 50 is used to control the
24 flow of cooled charge air to both banks of cylinders.
25 The cooled charge air is then driven through the two
26 branch conduits 54, 56 and along the straight
27 portions 58 of the branch conduits, in the direction
28 of the arrows 86, 88 shown in Fig. 2. The direction
29 86, 88 of air flow in the two branch conduits 58 is
30 thus opposite to the direction 82 of air flow in the
31 single charge air conduit 32.

1 Because the charge air conduit 32 is disposed in the
2 'V' between the two banks of cylinders, the space of
3 the engine 10 is used efficiently. It is not
4 necessary to provide a compressor and cooler together
5 with complex ducting on each side of the engine.
6 Instead the single compressor 21 and single cooler 40
7 can be fitted wherever is appropriate, for example at
8 opposed ends 13, 14 of the engine 10. The charge air
9 supply is divided at the 'Y' connector 52, so that
10 the only part of the charge air system which is
11 required on the external face of each bank of
12 cylinders is the straight portion 58 of each branch
13 conduit 54, 56, resulting in uncluttered external
14 faces of the engine 10.

15
16 It is to be understood that the geometric arrangement
17 of the components of the charge air system may be
18 varied to suit the layout of the engine with which
19 the charge air system is to be used.

20
21 The present invention provides a charge air system
22 which eliminates the air ducting complexity
23 associated with prior art charge air systems. By
24 keeping the air paths relatively straight line losses
25 are kept to a minimum and the air flow pressure is
26 optimised. The system may use only one compressor
27 and one charge air cooler, serving both banks of
28 cylinders, thereby reducing component and assembly
29 costs for the engine, although it is to be understood
30 that if required the system may use two or more
31 compressors and/or two or more charge air coolers.

1 CLAIMS

2
3 1. A charge air system for delivering charged air
4 from a compressor to a 'V' configuration internal
5 combustion engine having first and second spaced
6 banks of cylinders each defining a plurality of
7 combustion chambers, the system comprising:

8 a compressor outlet;

9 a charge air cooler having an inlet and an
10 outlet, said inlet being in communication with said
11 compressor outlet;

12 a first branch conduit adapted for communication
13 with said first bank of cylinders;

14 a second branch conduit adapted for
15 communication with said second bank of cylinders; and

16 a flow control valve in communication with said
17 outlet of said charge air cooler and in communication
18 with said first and second branch conduits.

19
20 2. The charge air system of Claim 1, further
21 including a connector having one inlet and two
22 outlets, said connector inlet being in communication
23 with said flow control valve and said two connector
24 outlets being in communication with said first and
25 second branch conduits respectively.

26
27 3. The charge air system of Claim 1 or 2, further
28 including a charge air conduit connecting said
29 compressor outlet and said charge air cooler inlet,
30 said charge air conduit including a substantially

1 straight portion adapted to be disposed between said
2 first and second spaced banks of cylinders.

3

4 4. An internal combustion engine comprising:

5 first and second spaced banks of cylinders each
6 defining a plurality of combustion chambers and a 'V'
7 space therebetween;

8 a compressor having a compressor outlet;

9 a charge air cooler having an inlet and an
10 outlet, said inlet being in communication with said
11 compressor outlet;

12 a first branch conduit in communication with
13 said first bank of cylinders;

14 a second branch conduit in communication with
15 said second bank of cylinders; and

16 a flow control valve in communication with said
17 outlet of said charge air cooler and in communication
18 with said first and second branch conduits.

19

20 5. The internal combustion engine of Claim 4,
21 further including a connector having one inlet and
22 two outlets, said connector inlet being in
23 communication with said flow control valve and said
24 two connector outlets being in communication with
25 said first and second branch conduits respectively.

26

27 6. The internal combustion engine of any one of
28 Claims 4 to 5, further including a charge air conduit
29 connecting said compressor outlet and said charge air
30 cooler inlet, said charge air conduit including a
31 substantially straight portion disposed in the 'V'

1 between said first and second spaced banks of
2 cylinders.

3

4 7. The internal combustion engine of Claim 6,
5 wherein said first and second branch conduits
6 each include a substantially straight portion
7 disposed on the opposite side of said first and
8 second spaced banks of cylinders respectively to said
9 substantially straight portion of said charge air
10 conduit,

11 and wherein the direction of air flow in said
12 substantially straight portions of said first and
13 second branch conduits is opposite to the direction
14 of air flow in said substantially straight portion of
15 said charge air conduit.

16

17 8. The internal combustion engine of any one of
18 Claims 4 to 7, wherein the engine has first and
19 second opposed ends, the compressor is provided at
20 the first end of the engine and the charge air cooler
21 is provided at the second end of the engine.

22

23 9. A method of delivering charged air from a
24 turbocharger compressor to a 'V' configuration
25 internal combustion engine having first and second
26 spaced banks of cylinders each defining a plurality
27 of combustion chambers, comprising:

28 causing charge air to flow from a compressor
29 outlet along a conduit disposed in the 'V' between
30 said first and second spaced banks of cylinders to a
31 charge air cooler;

1 cooling said charge air at said charge air
2 cooler;

3 causing cooled charge air to flow from said
4 charge air cooler to a flow control valve; and
5 controlling the flow of cooled charge air to a
6 first branch conduit connected to said first bank of
7 cylinders and a second branch conduit connected to
8 said second bank of cylinders by adjusting said flow
9 control valve.

10

11 10. The method of Claim 9, in which cooled charge
12 air flows from said flow control valve to an inlet of
13 a connector, said connector having two outlets,
14 cooled charge air flowing from each of said outlets
15 to said first and second branch conduits
16 respectively.

17

18 11. A charge air system for delivering charged air
19 from a compressor to a 'V' configuration internal
20 combustion engine having first and second spaced
21 banks of cylinders each defining a plurality of
22 combustion chambers substantially as hereinbefore
23 described and illustrated in the accompanying
24 drawings.

25

26 12. An internal combustion engine substantially as
27 hereinbefore described and illustrated in the
28 accompanying drawings.

29

30 13. A method of delivering charged air from a
31 turbocharger compressor to a 'V' configuration

(5)

1 internal combustion engine having first and second
2 spaced banks of cylinders each defining a plurality
3 of combustion chambers substantially as hereinbefore
4 described and illustrated in the accompanying
5 drawings.

1 ABSTRACT

2

3 "Engine Air Charge System with Branch Conduits"

4

5 Prior art air charge systems for 'V' configuration
6 internal combustion engines use two turbochargers and
7 two intercoolers, one for each bank of cylinders, and
8 require relatively long and complex air ducts. The
9 present invention provides a charge air system for a
10 'V' engine with two banks of cylinders. The system
11 includes a compressor connected by a charge air
12 conduit to a charge air cooler and a flow control
13 valve in communication with first and second branch
14 conduits, each adapted for connection to a bank of
15 cylinders. A branch connector has one inlet in
16 communication with the valve and two outlets in
17 communication with the two branch conduits. The
18 charge air conduit may be disposed in the 'V' between
19 the two banks of cylinders. The system uses one
20 compressor and one cooler, thereby reducing component
21 and assembly costs for the engine and keeping air
22 ducting relatively simple.

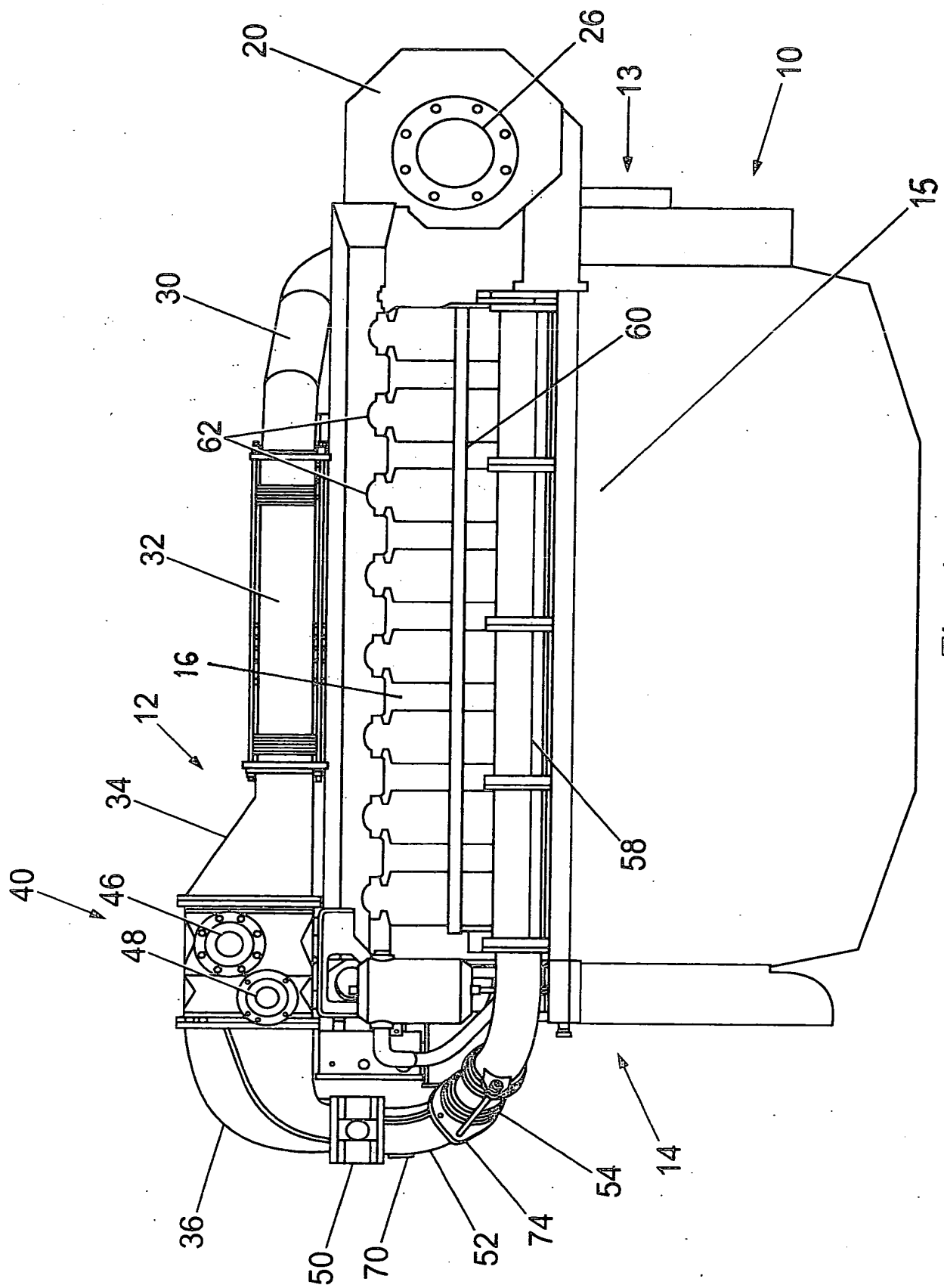


Fig. 1

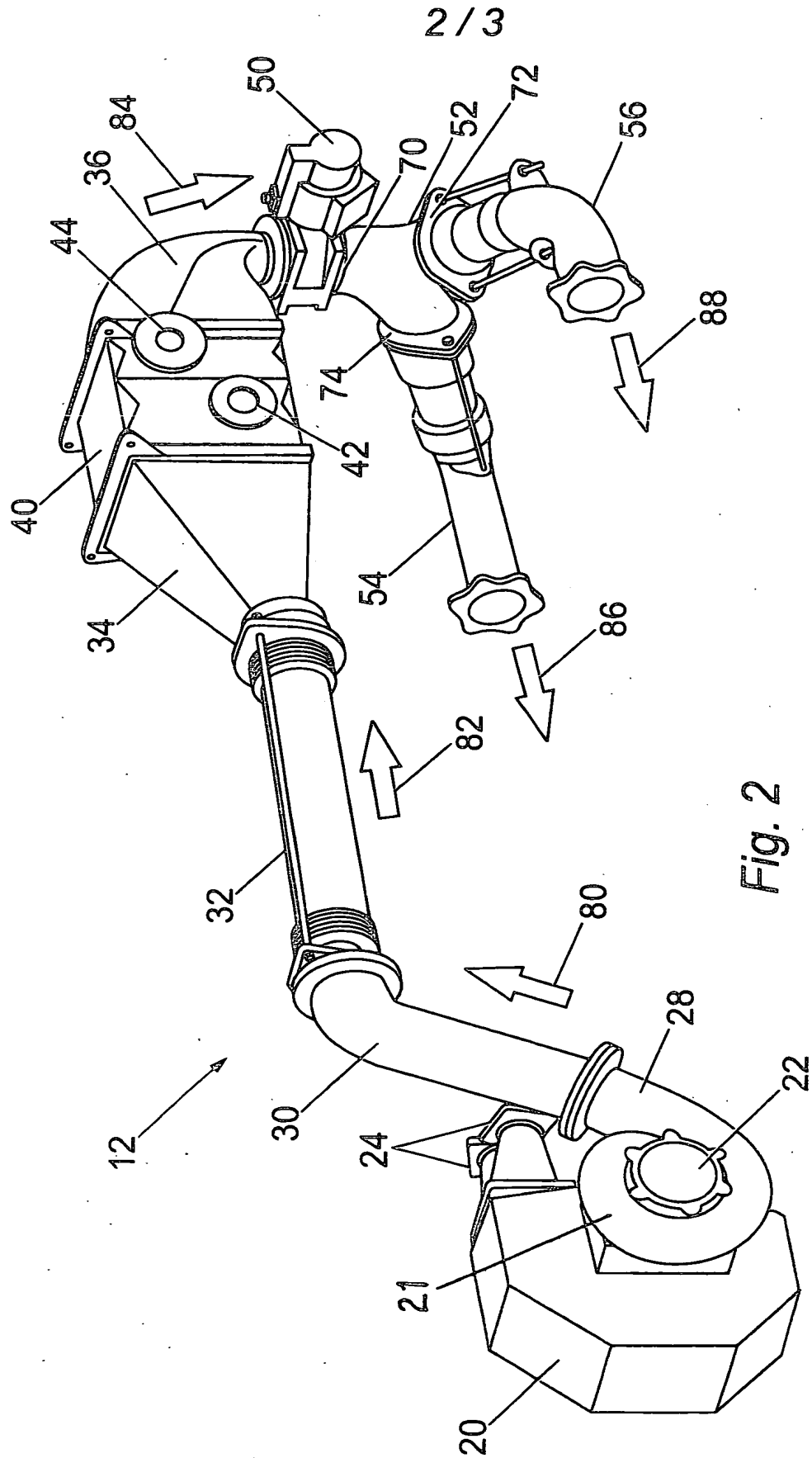


Fig. 2

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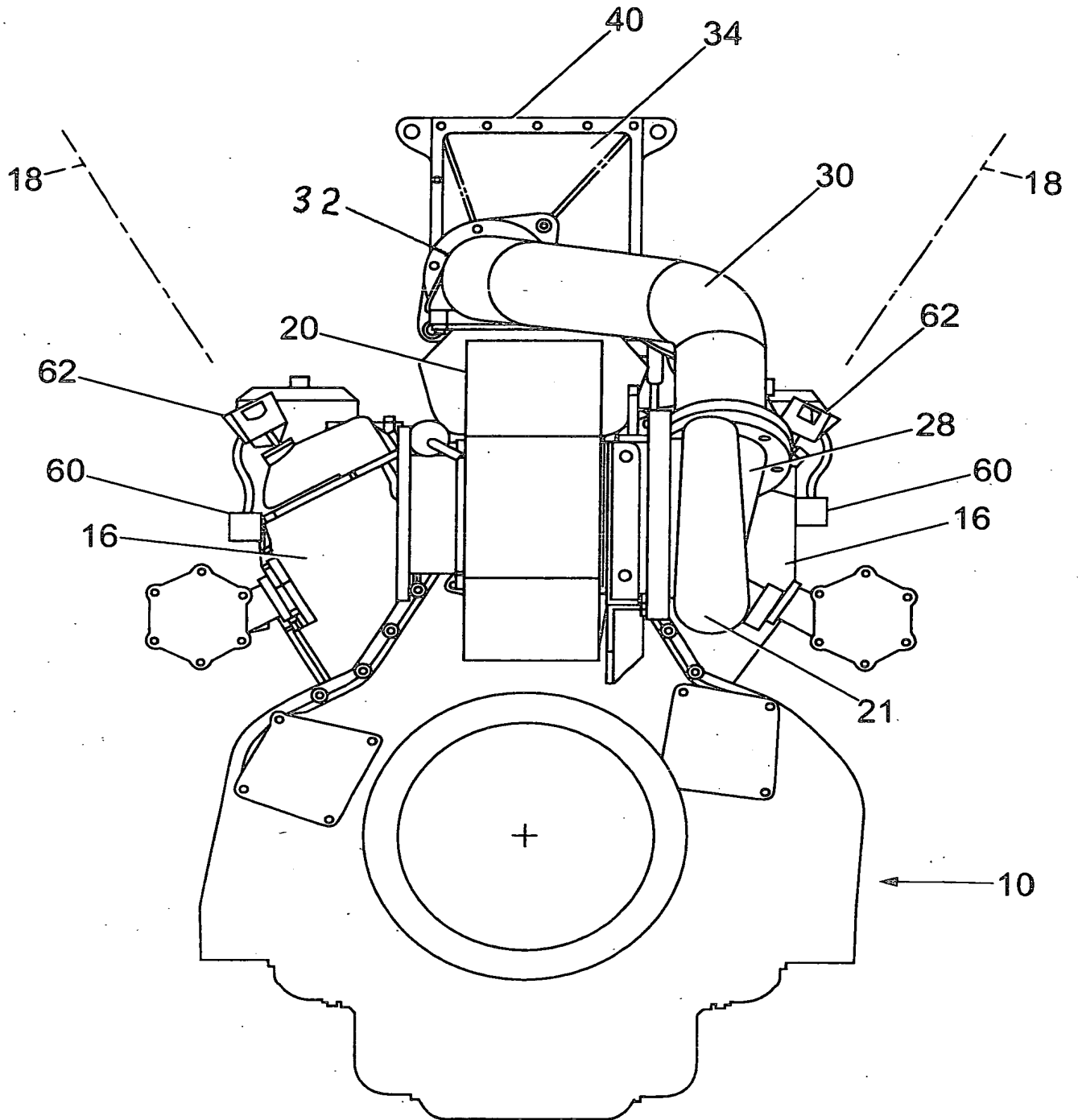


Fig. 3

